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The Heart of the Dairy Farm

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Automated Daily Analysis of Milk Components and Cow Behavior

Developing New Applications in The Dairy Herd

36th ICAR Session and Interbull Meeting 16-20 June 2008



Why Applications are Needed ?

- Herd size increasing
 - Sensors range and diversity is rising
- ⇒ Quantity of data increasing (resolution & innovative)
- Benefit for the end users → Applications
- ⇒ **Research for developing applications is needed**



Two New Advanced Sensors

- Afilab™ - Milk analyzer



- Pedometer+™ - Behavior meter

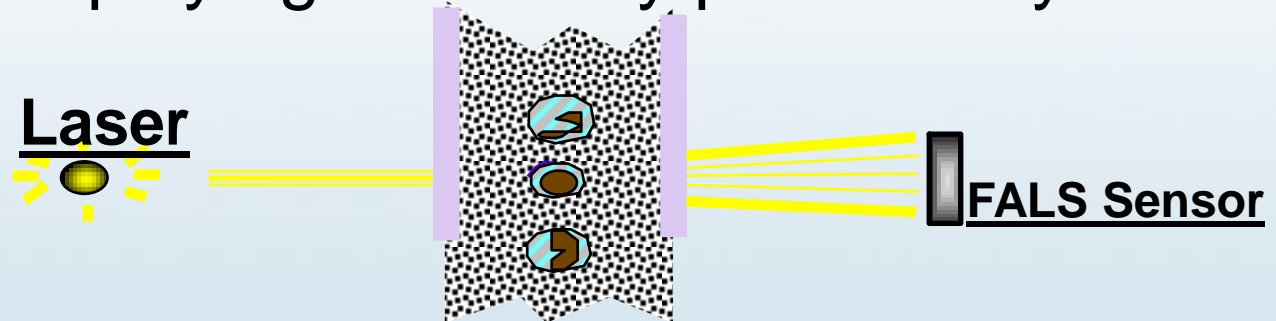




Milk Analyzer (Afilab™)

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- Measures milk solids (fat, protein, lactose)
- Indication – SCC, Blood
- Technology – Optical characteristics of light scattering off matter
- On-line, In-line (each stall)
- Concept – amplifying laboratory periodically tests





Field Study - Material & Methods

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S.A.E. Research Application Team (Schcolnik et. al.)

- Large commercial dairy farm (~800 milking cows)
- May 2007 – July 2007
- Analyzer data were recorded for each cow every milking
- Milk samples collected once a week – analyzed for solids and SCC - Israeli Milk Central Laboratory (Combi Milkoscan™, Foss)
- Blood samples for BHBA thrice weekly - fresh cows (1-21 DIM)
- Statistic analysis - JMP® 6, SAS





Derived Applications

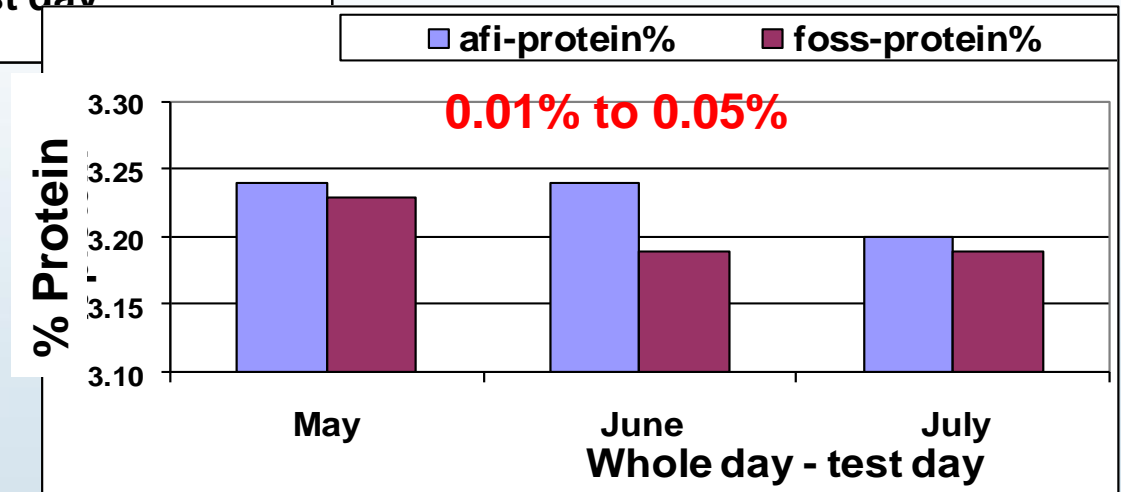
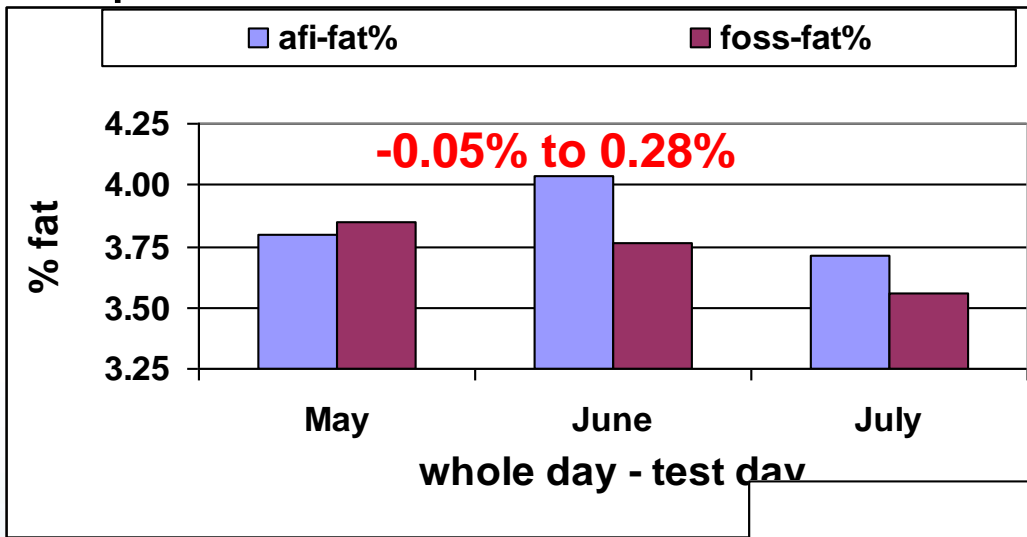
- Control nutritional status – herd and groups
- Individual feeding
- Predictions (diagnosis) metabolic diseases
- Follow ups dairies' milk payment
- Retrospective analysis
- Milk separation based on its quality
- Early detection of mastitis (under research)





Control nutritional status

- Milk components utilized with herd health program → rapid detection nutritional changes => metabolic and reproduction problems (Eicher, 2004)



Scholnik et al, 2007





Individual Feeding

- High importance – Management where supplement of additional concentrate feeding is needed (pasture, fresh cows, non homogenous groups)

NRC 2001 formula:

$$\text{DMI}_{(\text{kg/day})} = (0.372 * \text{FCM}^{0.75} + 0.0968 * \text{BW}) * (1 - e^{-0.192 * (\text{wol} + 3.67)})$$





Predictions (diagnosis) Metabolic Diseases

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- Correlation between metabolic diseases and milk components
- Ketosis (NEB) – Fat/Protein Ratio (FPR) > 1.35-1.50 (Heuer et. al., 1999)
- SARA – FPR < 1.0 or more then 10% with fat < 2.5% (Tomaszewski and Cannon, 1993; Nordlund et. al., 2004)





Predictions of Ketosis – Through FPR

FPR	BHBA > 1.4 (31.3%*)	
	Sensitivity (%)	Specificity (%)
> 1.2	59.3	56.1
> 1.4	33.3	82.7
> 1.6	11.1	92.4
> 1.8	2.8	98.3

* % of cases with BHBA above threshold





Predictions of Ketosis – Multifactorial Approach

FPR cut off	Model	
	FPR + 3 SHI* ²	
	Sensitivity	Specificity
1.30	73.0	68.3
1.35	69.6	71.7
1.40	60.9	77.1

* SHI – “Sound Health Indicators”

² Model FPR + activity, conductivity and urea (** 3/48, 125, 8.7, 17)

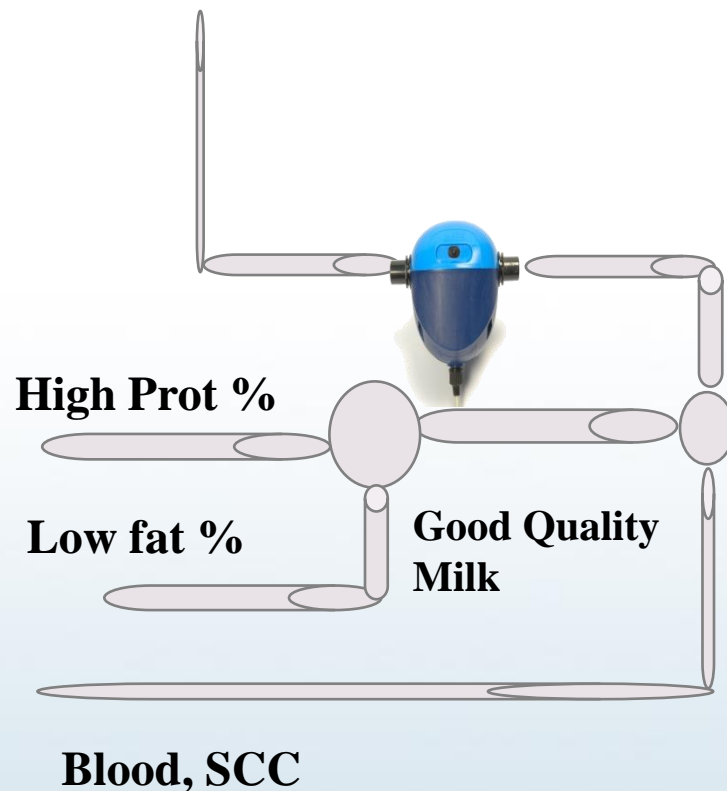
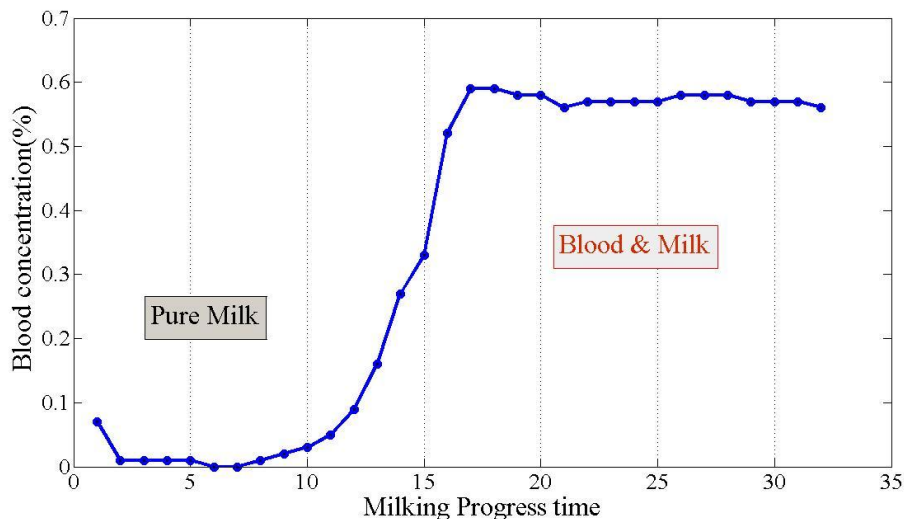




Milk Separation Based on Quality

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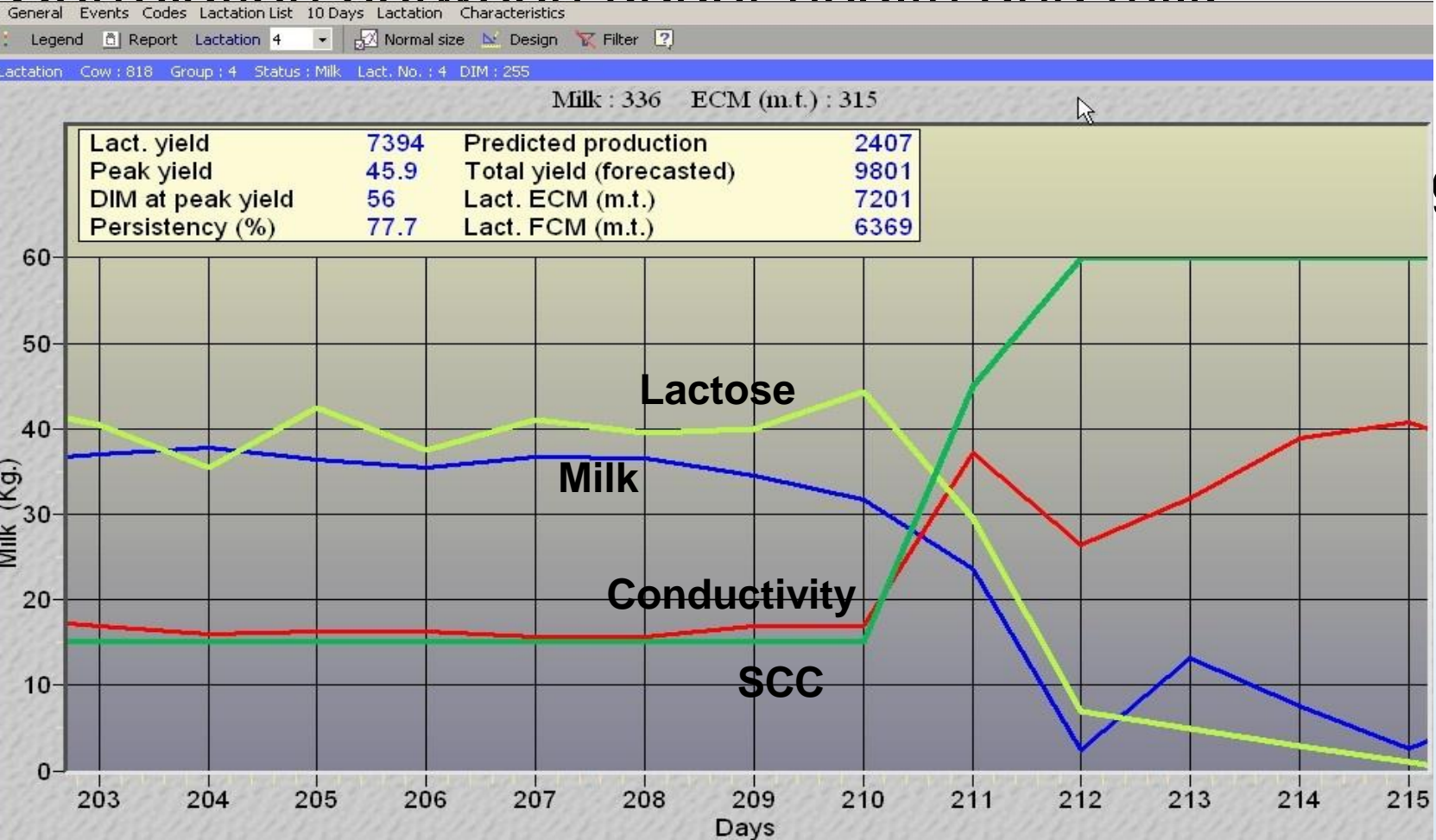
- Separation based on Protein%, SCC, presence of Blood



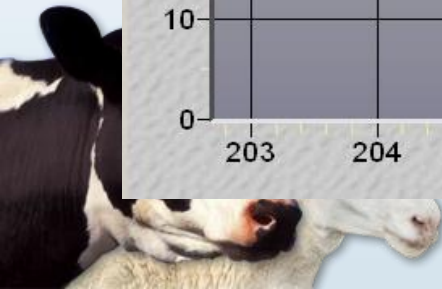


Early Detection of Mastitis

Mastitis – Case Report – Commercial Moshav Farm



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Derived Applications

- Control nutritional status – herd and groups
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Behavior Meter (Pedometer+™)

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- Records - activity (steps/hr), Lying time, Lying bouts
- Technology – 3 dimensional sensor
- Concept – determine routine behavior of the animal and pinpoint exceptions
- Animal Welfare & Comfort indication





Materials and Methods

A.R.O. The Volcani Center (Maltz et. al)

Study 1

- Commercial dairy farm (550 MC)
- 1st trial – lying behavior (12 MP)
- 2nd trial – two different barns – free stall vs. no stall (8*2 PP)
- 3rd trial – changed over 4 cows from each group
- Student T-test

Study 2

- Volcani Center dairy farm
- 14 cows prior calving
- 5 kg concentrates feed (1kg*5) using CCSF
- Activity, lying and feeding behavior – recorded last 7 days prior calving
- T-test (each day vs. previous day)





Derived Applications

- Animal Welfare & Comfort assessment
- Detecting calving time of dairy cows
- Heat detection under unfavorable condition (tie stall, heat stress)
- Define the optimal stocking density





Animal Welfare & Comfort Assessment

Lying time (mean ± SD) in between milking diurnal intervals of 8 cows in no stalls barn and in free stall barn

(activity ≥ 100%) => stable parameter

Time interval	Lying Time (min)
	No stall barn
Morning (04:00-12:00)	157±42 (29.4*)
Noon (12:00-20:00)	118±50 (22.1)
Night (20:00-04:00)	258±51 (48.4)

* % from daily lying time

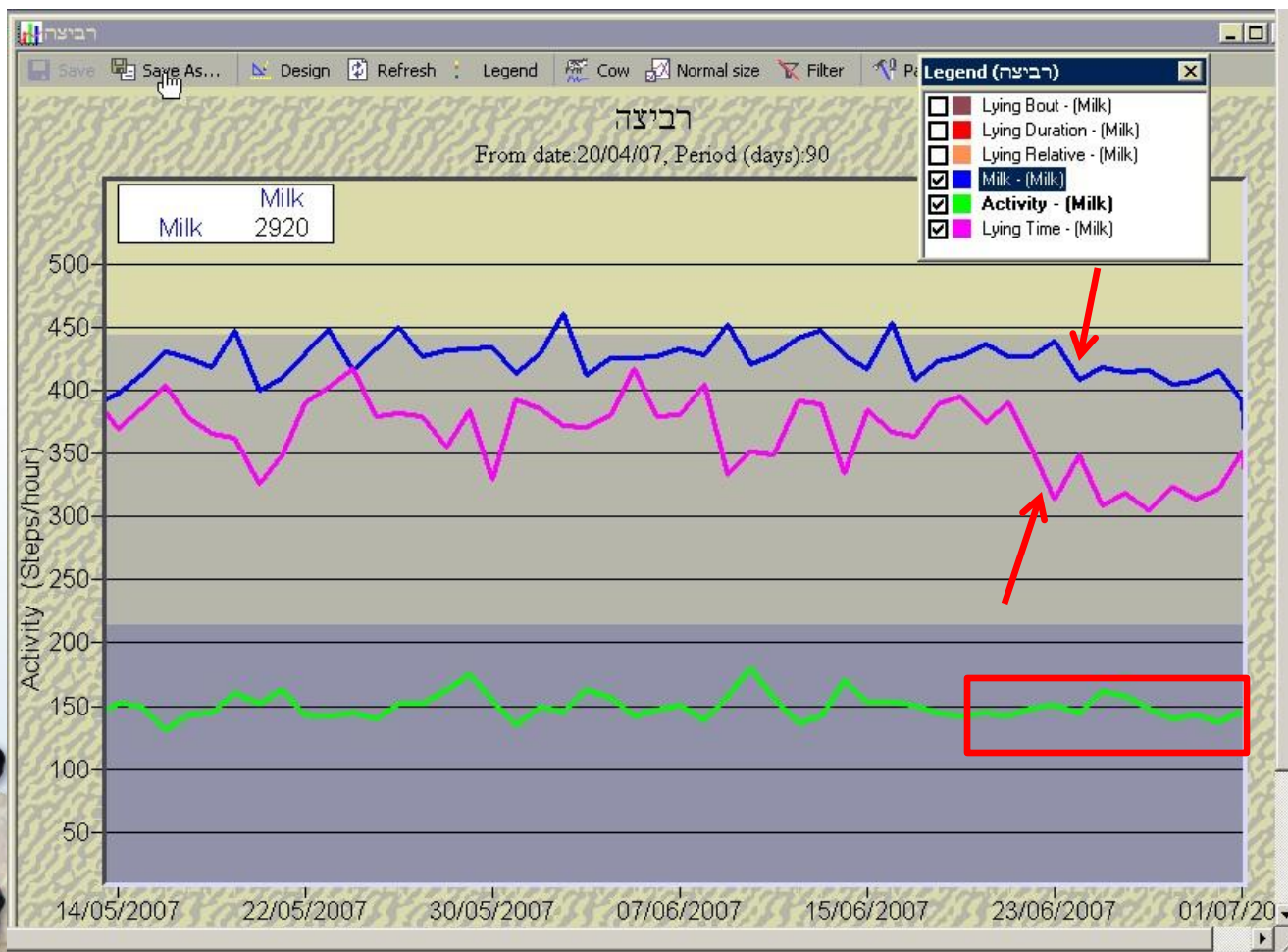
From Livishin et. al., 2005





Animal Welfare & Comfort Assessment

Heat Stress (During Israeli Summer) – Case Report – Lying behavior Vs. Activity Whole Group Level – Commercial Moshav Farm





Animal Welfare & Comfort Assessment

- Evaluation of housing management
Changing of Lying Time (minutes) after transferred between 2 different housing barns

Time Interval	Period 1	Period 2	Period 1	Period 2
	No stall	Free stall	Free stall	No stall
Morning (04:00-12:00)	153±41 ^{*a}	126±55	120±39 [*]	178±55 ^a

* p<0.01 of the same cows when transferred from one barn to the other

^a p<0.01 between groups (4 cows) inhabiting different barns within period



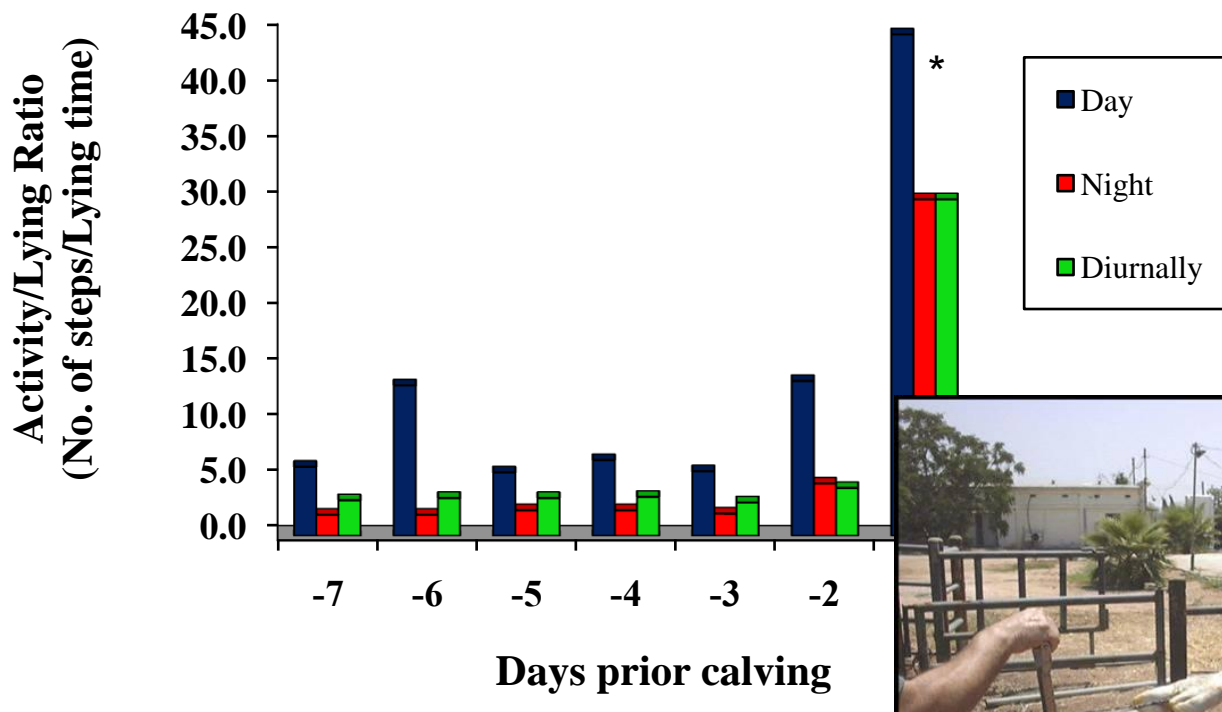


Detecting Calving Time

- Cows behavior change prior to calving
- *Activity/Lying ratio in the last 7 days prior to calving*

- Calv
- para
- Help
- Atter

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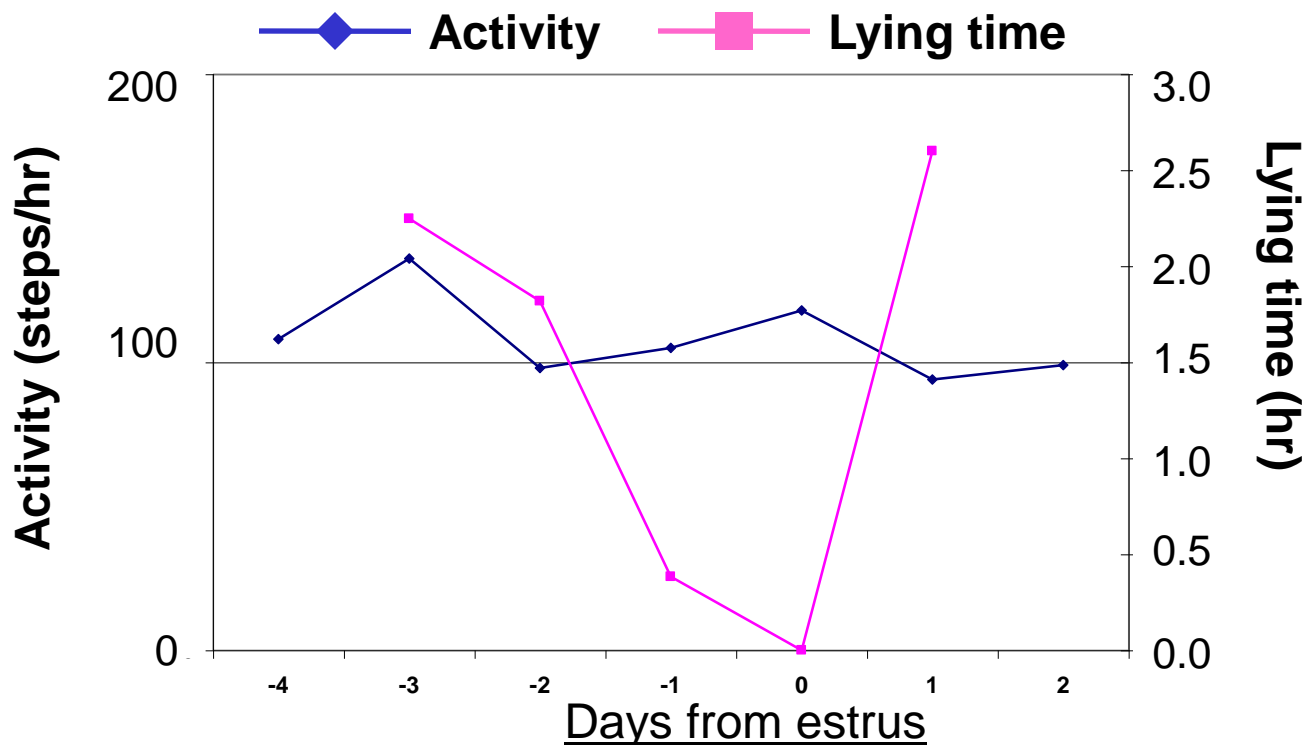
* $P < 0.01$ day -1 vs. day -2





Heat Detection in Unfavorable condition

Heat Detection – Case Report – Changing only in Lying Behavior





Derived Applications

- Animal Welfare & Comfort assessment
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Applications Derived from Interactions of Sensors



- Interaction between large range of data from varied sensors (Milk meter, Weight scale, Self feeders)
- Developing innovative models
- Developing new applications and improving established ones
- **Early** detection and **specify** of health, fertility and welfare problems



Summary



- Modern farm - Herd size increasing → Amount and range of data increasing
- Sophisticated applications are needed
- Applied research is required
- Two new advanced sensors developed by S.A.E. Afikim
- **The sky is the limit**



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THANK YOU

